International Journal of Surgery 12 (2014) 1141–1145

Contents lists available at ScienceDirect

International Journal of Surgery

journal homepage: www.journal-surgery.net

Original research

Comparison of skin incisions used for open lateral internal sphincterotomies – Radial versus circumferential incisions: A retrospective cohort study

Wook Ho Kang [a], Cheong Ho Lim [a], Dong Hyun Choi [b], Hyeon Keun Shin [c], Young Chan Lee [a], Seung Kyu Jeong [c], Hyung Kyu Yang [c,*]

[a] Department of Coloproctology, Yang Hospital, Namyangju, Republic of Korea
[b] Department of Coloproctology, Hansarang Hospital, Ansan, Republic of Korea
[c] Department of Coloproctology, Yang Hospital, Seoul, Republic of Korea

HIGHLIGHTS

- Lateral internal sphincterotomy (LIS) is a popular surgical treatment for fissure-in-ano.
- Radial or circumferential incisions are used for LIS, based on the surgeons' preference.
- We compared the two types of incisions used during LIS.
- Circumferential skin incisions are associated with shorter healing times than radial incisions.

ARTICLE INFO

Article history:
Received 15 August 2014
Accepted 3 September 2014
Available online 16 September 2014

Keywords:
Lateral internal sphincterotomy
LIS
Incision
Anal fissure
Wound

ABSTRACT

Introduction: Lateral internal sphincterotomy (LIS) is a safe and effective surgical treatment, commonly used in patients with chronic anal fissures (CAFs). Although LIS is a simple surgical technique, it may cause several complications. Open LIS is usually performed through an incision made in the intersphincteric groove; radial or circumferential incisions, used according to the surgeon's preference. However, differences in clinical outcomes and wound healing, based on type of skin incision, are unclear. We investigated incision site wound healing and other clinical outcomes, after open LIS, according to the type of skin incision employed. **Methods**: We retrospectively reviewed the data of the electronic medical records of 602 patients who underwent open LIS for CAFs between March 2005 and February 2010 at Yang Hospital, Seoul, Korea. **Results**: Of the 602 patients, 298 patients received radial incisions and 304 received circumferential incisions. Circumferential incisions of the anus reduced the wound healing time compared to radial incisions (19.1 vs. 24.0 days, $p < 0.001$). There were no significant differences between the groups in wound complications such as perianal abscess, fistula, or cellulitis. Clinical outcomes including recurrence, persistence of fissures, and continence problems were also similar between the groups. **Conclusions**: Our study shows that circumferential skin incisions, during LIS, are associated with shorter healing times than radial incisions.

1. Introduction

Lateral internal sphincterotomy (LIS) is a safe, effective, and popular surgical treatment for chronic anal fissures (CAFs), and can be performed by either an open or a closed technique [1]. The method originally described by Eisenhammer in 1959 was performed by the open technique, which divides the internal sphincter through an opened wound made on the intersphincteric groove [2]. The open technique was also used by Parks [3] with a "circumferential incision" along the anal verge in the intersphincteric groove, but Ray et al. [4] used a "radial incision" during LIS. Later, the closed technique was introduced by Notaras [5] and Hoffmann and Goligher [6]. They divided the internal sphincter, using a narrow-bladed scalpel by palpation without direct vision. There have been many studies comparing the open and closed techniques. Some authors reported that LIS performed by the

* Corresponding author. Department of Coloproctology, Yang Hospital, 1159, Chunho-daero, Gangdong-gu, Seoul 134-814, Republic of Korea.
E-mail address: bridge1111@naver.com (H.K. Yang).

http://dx.doi.org/10.1016/j.ijsu.2014.09.005
1743-9191/

closed technique had lower complication rates than that by the open technique [7–9], but others reported that both of the techniques had no meaningful differences in complications [10–13]. Therefore, until now, no definitive guidelines have been shown on the choice of the open or closed technique for performing LIS. Despite lacking absolute guidelines, many surgeons still favor the open technique for LIS [14].

Most surgeons who prefer the open LIS procedures use either the radial [4,10,15] or the circumferential incision [3,8,16], based on their individual experience and preference. Although there have been some reports about various surgical techniques that could promote wound healing after open LIS [15,16], there has been only one publication comparing the two types of incisions used for open LIS: Ersoz et al. reported that parallel (circumferential) incision significantly reduced wound healing time and itching sensation, compared to vertical (radial) incision [17]. They suggested that the change of the wound shapes and the degree of the fecal contamination during defecation could be the possible reasons for their results. However, since their report, there have been no further studies comparing the two types of incisions. Therefore, we planned this study to confirm the influence by the direction of the incisions used for the open LIS on wound healing.

We hypothesized that the degree of fecal contamination of the LIS incision sites during defecation would affect wound healing after LIS and the radial incision wound would be more vulnerable to fecal contamination than the circumferential incision wound. Thus, we investigated wound healing and clinical outcome differences related to the two types of LIS-associated incisions to verify our hypothesis.

2. Patients and methods

2.1. Patients

The protocol of this study was reviewed and approved by the Yang Hospital Institutional Review Board. The data for this study were obtained by the review of the electronic medical records (EMR) in Yang Hospital, Seoul, Korea. Data collection was conducted by an independent researcher who was not involved in the surgeries. 1356 patients underwent the open LIS for CAFs from March 2005 to February 2010. Of the 1356 patients, 322 patients who underwent LIS and fissurectomy, combined with sliding skin grafts, and 151 patients who underwent LIS, combined with other anorectal surgical procedures, such as hemorrhoidectomy, were excluded from the study; 16 patients were also excluded from the study because of their histories of previous anorectal operations; 254 patients who underwent LIS were excluded due to their unsutured wounds; and 11 patients were lost to follow-up, thus also excluded. Finally, 602 patients were evaluated as part of this study. Among the included patients, none had disorders that may have affected wound healing, such as anal tuberculosis, Crohn's disease, and ulcerative colitis. The surgeries were performed by 8 certified, experienced colorectal surgeons who have performed benign anorectal operations with more than 5 years of experience in order to minimize bias due to the variation in the surgeons' skills.

The medical records were reviewed, in detail, to determine if postoperative complications had occurred and to confirm wound healing times. Wound healing time was defined as the period required for complete healing of LIS wounds, to the point that LIS site discharge and tenderness were resolved. Unhealed fissures were defined as fissures that did not heal within two months after the surgery. Recurrence was defined as the reappearance of an anal fissure more than 2 months after complete postoperative healing had occurred.

2.2. Preoperative evaluation

All patients underwent initial history and proctoscopic assessment to exclude any coexistent anorectal pathology. Anal tone was checked during a rectal examination, and only patients with anal hypertonia were planned for LIS. Colonoscopy or sigmoidoscopy was performed preoperatively whenever possible; however, for patients with severe pain, which precluded this examination, it was postponed until surgical wounds had healed. Preoperative anorectal manometry was performed, using an eight channel transducer (PIP-4-8SS; Mui Scientific, Ontario, Canada). Maximal resting and squeeze pressures were measured by a stationary pull-through technique.

2.3. Operative technique

All patients were admitted on the day of surgery. Mechanical bowel preparation was not performed preoperatively. Prophylactic parenteral antibiotics were not administered. All procedures were performed in the prone jackknife position, under spinal anesthesia. The buttocks were retracted, laterally, using plasters. The surgical site was cleansed with 10% povidone-iodine, and, at the discretion of the surgeon, the area may or may not have been infiltrated with 0.25% bupivacaine (1:200,000 in epinephrine). All patients underwent open LIS. According to the preference and experience of each surgeon, a radial or circumferential incision, approximately 1–1.5 cm long, was made just distal to the intersphincteric groove on the lateral aspect of the anus (Fig. 1a, b). The anoderm was separated from the internal sphincter up to the dentate line using mosquito forceps, and the distal internal sphincter was divided up to the level of dentate line, using electric diathermy under direct vision; hemostasis was achieved using standard unipolar electrocautery. Each skin incision was closed using one or two chromic catgut sutures.

2.4. Postoperative management and follow-up

The patients were discharged two days after surgery and allowed to consume a regular diet. They were instructed to take sitz baths 2–3 times/day; oral metronidazole (250 mg, three times daily for 2 weeks), analgesics, and stool softeners, such as a psyllium seed preparation, were also prescribed. The patients were examined in the surgical outpatient clinic one week after surgery, and subsequent follow-ups were scheduled every 1–2 weeks until healing was complete. After complete healing was achieved, each patient was reexamined after one month. The patients were instructed to return to the outpatient clinic in the event of any inconvenient symptoms.

For patients who were not followed clinically for more than one year after surgery, long-term follow-up was performed by telephone. Telephone consultants called the patients to assess the development of symptoms, such as anal pain, bleeding on defecation, gas or fecal incontinence, fecal soiling, and other anal discomforts.

2.5. Statistical methods

Statistical analyses were performed using SPSS, version 12.0 (SPSS, Chicago, IL, USA). Student's *t*-test was used to compare ages, body mass indexes, healing times, and follow-up periods between the 2 groups of patients; Pearson's χ^2 test was used to compare sex, fissure location, LIS location, and recurrence. Postoperative complications, except recurrence, were compared between groups using Fisher's exact test. All presented values are two-tailed; a p-value <0.05 was considered statistically significant.

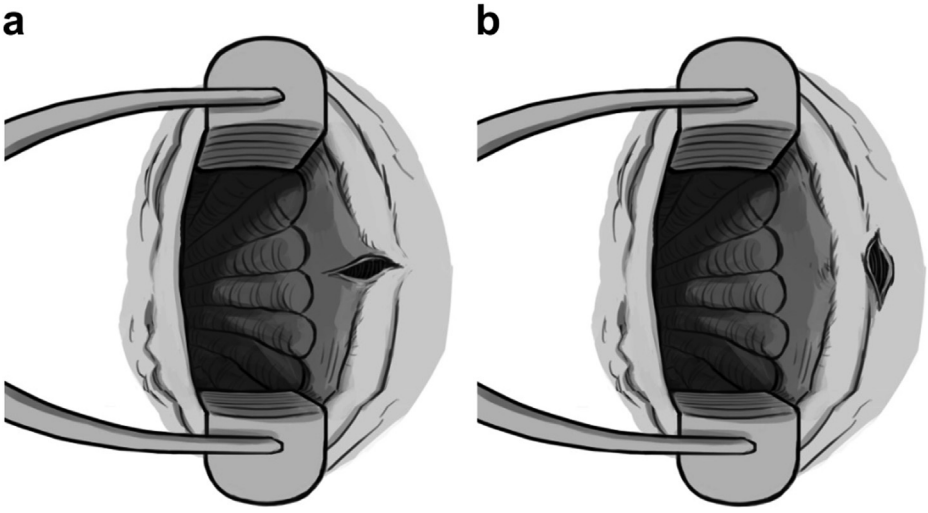

Fig. 1. Skin incision methods for lateral internal sphincterotomies. (a) A radial skin incision. (b) A circumferential skin incision.

3. Results

3.1. Demographics

The two groups (radial and circumferential incision groups) were similar with respect to age, sex, fissure locations, LIS locations, body mass indexes, American Society of Anesthesiologists (ASA) classification, and anorectal manometric results (Table 1). Long-term follow-up for over one year was possible for 71.8% (432/602) of the patients by visits or telephone calls, and there was no difference in the follow-up between the groups (217/298 [72.8%], vs. 215/304, [70.7%], $p = 0.568$). The average follow-up duration for the entire patient population was 34 (range, 2–92) months, and there was no statistical difference between the radial and circumferential incision groups (35.7 ± 31.3 vs. 32.3 ± 28.7 months, respectively, $p = 0.169$).

Table 1
Clinical characteristics of patients undergoing lateral internal sphincterotomies (radial vs. circumferential incisions).

	Radial incisions ($n = 298$)	Circumferential incisions ($n = 304$)	p-value
Age (years)	39.5 ± 12.1	38.2 ± 11.8	0.177
Sex			0.970
Male	122 (40.9)	124 (40.8)	
Female	176 (59.1)	180 (59.2)	
Location of fissure			0.284
Posterior midline	194 (65.1)	180 (59.2)	
Anterior midline	49 (16.4)	53 (17.4)	
Both	35 (11.8)	53 (17.4)	
Lateral	8 (2.7)	5 (1.7)	
Multiple	12 (4.0)	13 (4.3)	
Location of LIS			0.247
Left lateral	260 (87.2)	278 (91.4)	
Right lateral	28 (9.4)	19 (6.3)	
Bilateral	10 (3.4)	7 (2.3)	
Body mass index	23.7 ± 3.5	23.6 ± 3.3	0.658
ASA classification			
1	242 (81.2)	254 (83.6)	0.744
2	53 (17.8)	47 (15.4)	
3	3 (1.0)	3 (1.0)	
MRP (cmH_2O)	134.8 ± 39.5	133.6 ± 39.7	0.706
MSP (cmH_2O)	250.3 ± 85.3	246.9 ± 87.9	0.641

Data are presented as numbers (percentages) or means ± standard deviation.
LIS, lateral internal sphincterotomies; ASA, American Society of Anesthesiologists; MRP, Maximal resting pressure; MSP, Maximal squeeze pressure.

3.2. Complications

Wound complications such as perianal abscess, fistula, and cellulitis were slightly more common in radial incision group than in circumferential group, but, there were no statistically significant differences between the groups (Table 2). Of the 11 patients who developed perianal abscesses at the LIS site, 8 were treated with incision and drainage and 3 underwent fistulotomy. Four patients developed anal, intersphincteric fistulas, after LIS, and underwent fistulotomy; 4 patients developed cellulitis at the LIS site and underwent oral cephradine treatment (500 mg, three times daily for 2 or 3 weeks) until healed. Five patients experienced delayed wound healing and were cured with conservative management (e.g., sitz baths and oral stool softeners; 4 healed within 3 months, 1 required 4 months to heal); 1 patient with wound dehiscence was healed following 30 days of conservative treatment (sitz baths). Other complications, unrelated to the LIS wound, such as fissure persistence or recurrence and continence problems, were not statistically different between the groups.

3.3. Wound healing time

The mean LIS wound healing time was significantly shorter for the circumferential incision group (19.1 days) than for the radial incision group (24.0 days, $p < 0.001$) (Table 2). In the circumferential incision group, 47.0% (143/304) of the patients healed within 14 postoperative days, whereas only 28.5% (85/298) of the radial incision group were healed within the same period (Table 3). Although the patients requiring more than 28 days for wound healing accounted for 10.2% (31/304) of the circumferential incision group patients, 22.2% (66/298) of the patients in the radial incision group required more than 28 days of healing.

4. Discussion

LIS was first proposed by Eisenhammer [2] in 1959, and has become a commonly used surgical treatment for CAFs. Originally, LIS was performed as an open technique [2–4], and later a closed technique was also introduced [5,6]. Although LIS is a safe surgical procedure, some patients experience wound complications, such as perianal abscess or fistula formation [7]. Some researchers have reported that would complications are less likely to occur when LIS is performed using the closed technique than with the open

Table 2
Differences in complications and clinical outcomes between patients undergoing lateral internal sphincterotomies with either radial or circumferential skin incisions.

	Radial incisions ($n = 298$)	Circumferential incisions ($n = 304$)	p-value
Perianal abscess	7 (2.4)	4 (1.3)	0.379
Perianal fistula	3 (1.0)	1 (0.3)	0.369
Cellulitis	4 (1.3)	0 (0.0)	0.059
Delayed wound healing	3 (1.0)	2 (0.7)	0.683
Wound dehiscence	1 (0.3)	0 (0.0)	0.495
Unhealed fissure	1 (0.3)	3 (1.0)	0.624
Recurrence	13 (4.4)	14 (4.6)	0.886
Gas incontinence	2 (0.7)	3 (1.0)	1.000
Fecal incontinence	3 (1.0)	2 (0.7)	0.683
Fecal soiling	5 (1.7)	4 (1.3)	0.750
Urgency	1 (0.3)	0 (0.0)	0.495
Fecal impaction	0 (0.0)	2 (0.7)	0.499
Voiding difficulty	1 (0.3)	1 (0.3)	1.000
Headache	3 (1.0)	2 (0.7)	0.683
Healing time (days)	24.0 ± 17.0	19.1 ± 12.2	<0.001
Follow-up periods (months)	35.7 ± 31.3	32.3 ± 28.7	0.169

Data are presented as numbers (percentages) or means ± standard deviation.

Table 3
Wound healing times following lateral internal sphincterotomies (radial vs. circumferential incisions).

Postoperative periods (days)	Radial incisions ($n = 298$)	Circumferential incisions ($n = 304$)
<14	85 (28.5)	143 (47.0)
14–28	147 (49.3)	130 (42.8)
>28	66 (22.2)	31 (10.2)

Data are presented as numbers (percentages).

approach [7–9]. However, others have reported that there are no differences in the clinical outcomes between open and closed sphincterotomies [10–13]. Furthermore, García-Granero et al. [18] reported that the closed technique increases the risk of incomplete resection of the internal sphincter, and a textbook recommends the open LIS approach for surgeons who are less familiar with the anorectal anatomy or who are inexperienced in this type of surgery [1]. As we agree with the opinion of García-Granero et al. [18], we prefer the open technique and use either radial incision or circumferential incision depending on the individual surgeon's experience and preference.

There have been some reports comparing the various open LIS techniques and their associated wound healing rates and complications. Aysan et al. [16] reported that the primary closure of LIS wounds was beneficial for reducing wound healing times, but did not have a significant effect on wound-related complications compared with secondary healing. Kang et al. [15] suggested that marginal incision sutures, after LIS, were beneficial for reducing complications related to early wound healing. However, there have been few publications regarding the direction of the incision, itself, rather than the suture method. To the best of our knowledge, there has been a single publication reporting clinical outcomes, based on the direction of the incision: Ersoz et al. [17] reported that incisions made parallel (circumferentially) to the anus significantly shortened the wound healing time and the duration of perianal itching, compared to vertical (radial) incisions [17]. Similarly, our results also showed that the wound healing time of the circumferential incision group was significantly shorter than that of the radial incision group ($p < 0.001$) (Table 2). Ersoz et al. [17] explained the reasons for their results as follows: During defecation, fecal material creates “outward force vectors” in a circular fashion resulting in extensive dilatation of the anal canal. For vertical (radial) incisions, the force vectors separate the wound margins during defecation, increasing the possibility of fecal contamination of the wound and delaying healing. They also suggested that a parallel (circumferential) incision prevents separation of the wound edges, allowing better wound margin apposition and, thereby, contributing to faster wound healing. In our study, one patient (0.3%) in the radial incision group suffered wound dehiscence that could be explained by these outward force vectors (Table 2). Thus, we agree with the opinion of Ersoz et al. [17] and believe that longer wound healing times following radial skin incision may be explained by the increased chance of fecal wound contamination. However, we suggest that additional explanations may exist for the high chance of fecal wound contamination in LIS patients with radial incisions. As illustrated in Fig. 1a, b, a radial incision wound may be closer to the inside of the anal canal than a circumferential incision. Furthermore, during the meticulous dissection through the incision, the anoderm around the edge of the incision may be torn along the incision line due to excessive traction, making the wound of the radial incision closer to the anal canal. This relatively shorter distance to the anal canal may help to explain the increased possibility of fecal contamination of the radial incision.

According to the results of Ersoz et al. [17], wound complications between the radial (vertical) and circumferential (parallel) incision groups were not different. In our study, there were also no significant differences between the groups in wound complications. It has been known that perianal abscess or fistula may be related to the penetration of anal mucosa during dissection into the intersphincteric space, rather than to the fecal contamination of the incision site [19]. As the surgeons involved in our study had similar experience and proficiency of surgical skills, significant differences of the complication rates were not found.

This study had some limitations. The most obvious limitation is its retrospective design, which we partially overcame by increasing the study size. And we used the data stored in the EMR, so more accurate chart review was possible. Another limitation is the relatively short follow-up periods for the patients. We used follow-up telephone calls to track longer-term outcomes of some patients after their last clinical visits. Furthermore, all operations were performed by experienced surgeons and the possible bias due to the differences of the surgeons' skills was minimized.

In conclusion, our results suggest that the rate of wound healing is faster following open LIS for CAF when a circumferential incision is used rather than a radial incision. Further studies, however, may be needed to validate our results.

Ethical approval

This study was approved by the Yang Hospital Institutional Review Board under the approval number of 196452-HR-00001.

Funding

None.

Author contribution

Wook Ho Kang: Study design, data collection, data analysis, writing manuscript, final approval of the manuscript.

Cheong Ho Lim: Study design, data collection, data analysis, final approval of the manuscript.

Dong Hyun Choi: Data collection, data analysis, final approval of the manuscript.

Hyeon Keun Shin: Data collection, data analysis, final approval of the manuscript.

Young Chan Lee: Data collection, data analysis, final approval of the manuscript.

Seung Kyu Jeong: Data collection, data analysis, final approval of the manuscript.

Hyung Kyu Yang: Principal investigator, study design, data analysis, final approval of the manuscript.

Conflicts of interests

No conflicts of interests declared.

References

[1] P.H. Gordon, Fissure-in-ano, in: P.H. Gordon, S. Nivatvongs (Eds.), Principles and Practice of Surgery for Thecolon, Rectum and Anus, third ed., Informa Healthcare USA, New York, 2007, pp. 167–189.
[2] S. Eisenhammer, The evaluation of the internal anal sphincterotomy operation with special reference to anal fissure, Surg. Gynecol. Obstet. 109 (1959) 583–590.
[3] A.G. Parks, The management of fissure-in-ano, Hosp. Med. 1 (1967) 737–738.
[4] J.E. Ray, J.C.B. Penfold, J.B. Gathright, S.H. Roberson, Lateral subcutaneous internal anal sphincterotomy for anal fissure, Dis. Colon Rectum 17 (1974) 139–144.
[5] M.J. Notaras, Lateral subcutaneous sphincterotomy for anal fissure-a new technique, Proc. R. Soc. Med. 62 (1969) 713.
[6] D.C. Hoffmann, J.C. Goligher, Lateral subcutaneous internal sphincterotomy in treatment of anal fissure, Br. Med. J. 3 (1970) 673.
[7] W.A. Walker, D.A. Rothenberger, S.M. Goldberg, Morbidity of internal sphincterotomy for anal fissure and stenosis, Dis. Colon Rectum 28 (1985) 832–835.
[8] J. Garcia-Aguilar, C. Belmonte, W.D. Wong, A.C. Lowry, R.D. Madoff, Open vs. closed sphincterotomy for chronic anal fissure, Dis. Colon Rectum 39 (1996) 440–443.
[9] J. Kortbeek, J. Langevin, R. Khoo, J. Heine, Chronic fissure-in-ano: a randomized study comparing open and subcutaneous lateral internal sphincterotomy, Dis. Colon Rectum 35 (1992) 835–837.
[10] T.H. Lewis, M.L. Corman, E.D. Prager, W.G. Robertson, Long-term results of open and closed sphincterotomy for anal fissure, Dis. Colon Rectum 31 (1988) 368–371.
[11] R.L. Nelson, Meta-analysis of operative techniques for fissure-in-ano, Dis. Colon Rectum 42 (1999) 1424–1428.
[12] A. Arroyo, F. Perez, P. Serrano, F. Candela, R. Calpena, Open versus closed lateral sphincterotomy performed as an outpatient procedure under local anesthesia for chronic anal fissure: prospective randomized study of clinical and manometric long-term results, J. Am. Coll. Surg. 199 (2004) 361–367.
[13] P.B. Boulos, J.G. Araujo, Adequate internal sphincterotomy for chronic anal fissure: subcutaneous or open technique? Br. J. Surg. 71 (1984) 360–362.
[14] S. Argov, O. Levandovsky, Open lateral sphincterotomy is still the best treatment for chronic anal fissure, Am. J. Surg. 179 (2000) 201–202.
[15] G.S. Kang, B.S. Kim, P.S. Choi, D.W. Kang, Evaluation of healing and complications after lateral internal sphincterotomy for chronic anal fissure: marginal suture of incision vs. open left incision: prospective, randomized, controlled study, Dis. Colon Rectum 51 (2008) 329–333.
[16] E. Aysan, A. Aren, E. Ayar, A prospective, randomized, controlled trial of primary wound closure after lateral internal sphincterotomy, Am. J. Surg. 187 (2004) 291–294.
[17] F. Ersoz, S. Arikan, S. Sari, H. Bektas, O. Ozcan, Type of lateral internal sphincterotomy incision: parallel or vertical? World J. Surg. 35 (2011) 1137–1141.
[18] E. García-Granero, A. Sanahuja, S.A. García-Botello, et al., The ideal lateral internal sphincterotomy: clinical and endosonographic evaluation following open and closed internal anal sphincterotomy, Colorectal Dis. 11 (2009) 502–507.
[19] S.P. Jobanputra, Anal fissure, in: M.L. Corman, R.J. Nicholles, V.W. Fazio, et al. (Eds.), Corman's Colon and Rectal Surgery, sixth ed., Lippincott Williams & Wilkins, Philadelphia, 2013, pp. 346–366.